HEPBURN

Methods of sampling cream for testing and their relation to creamery practice

Dairy Husbandry

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METHODS OF SAMPLING CREAM FOR TESTING AND THEIR RELATION TO CREAMERY PRACTICE

BY

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B. S. University of Illinois, 1907

THESIS

Submitted in Partial Fulfillment of the Requirements for the

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Nelson William Hepburn

ENTITLED Methods of Sampling Cream and Their Relation to Creamery Practice.

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Master of Science

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INTRODUCTION

For several years past, butter fat as determined by the Babcock test has been used as a paying basis for the dairy product delivered to our creameries, yet, after these years of experience those who have watched the development of the various systems of testing and sampling are realizing only too well that many of those systems approved or disapproved by common consent, may or may not be giving results which are mutually satisfactroy to both manufacturer and patron.

Since butter fat is the basis of all creamery calculation and in turn the basis of payment for the product from the farm, it is imperative that the method or methods followed be consistent to a degree where they will work neither a hardship to the manufacturing concern nor to the patron of the plant.

It is generally conceded that the Babcock test, properly manipulated, is the easiest, the most accurate and economical, means in the hands of the creamerymen for testing milk and cream for fat and the points of dispute and subjects for popular and scientific discussion are more intimately associated with systems of sampling, and particularly composite versus individual sampling. Unfortunately, owing to the newness of the problem, there is little or no reliable data dealing with the sampling of cream for testing in a commercial way. However, popular statements and sentiments are afloat which are constantly reflecting discredit on systems now in use and creating dissatisfaction among creamery patrons already half inclined to doubt the reliability of any part of the method followed.

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It is not the purpose of this thesis to advocate any one method of sampling as being accurate above all others, for it is perfectly clear that if it should appear that any or all the systems give equally good results, they would not all be applicable to every condition. For example, our larger and many of our smaller centralizers pay for each delivery or shipment of cream. This in itself presupposes the testing of every can of cream as it arrives and the system of sampling automatically regulates itself. It will further appear that the experience of the operator may become a limiting factor in determining the system to be used, for what might be followed with success by one might result in total failure in the hands of another. In other words, our creamery system is in the hands of a heterogeneous lot; some of them belonging to the so-called new school of dairying, others to that type popularly termed the "Old school buttermakers". Some have been far sighted enough to read the tendency of the times and are rapidly remodeling their old notions to suit the new systems so fast coming into use; still others, successful while non-competitive systems were in vogue, under the changed methods of handling the dairy product are finding themselves either forced out of the field or compelled to be allied with a non-remunerative business.

Pioneers in the dairy industry, especially those connected with the manufacturing process, recognized no other system than that of delivering the butter fat in the form of whole milk, giving the buttermaker the opportunity of handling the product from the stage of the raw material to the manufactured article, butter. The recent change, however, from the whole milk to the hand separator system marks, from the economists standpoint, a new era in dairying, inasmuch as it involves the questions of economy of delivery, manufacture, transportation and feeding of dairy by-products, as well as the

conservation of the elements of fertility of the soil. This sudden change in caring for the dairy farm product is no doubt responsible for the present agitation on questionable methods of sampling cream which are in most cases the result of a justifiable effort to decrease the laborious process of testing. Therefore, the material presented refers wholly to cream testing and sampling, altho data collected coincident with this would lead one to believe that our present systems relating to milk are more than equally open to criticism.

Testing Apparatus

IMPORTANCE OF TESTING

It is a trite expression among creamery inspectors, that testing does not occupy the prominent place it should in creamery practice, indicating that few are cognizant of the disastrous results of careless testing or practices of sampling, which may lead to an inaccurate determination of butter fat. If the test combined with the creamery sales are to be used as a basis for payment, then they bear the same relation to that industry that a system of weights and measures do to any commercial business. Few realize that Creamery Overrun, one of the chief sources of creamery revenue will on a 40-percent cream basis be increased or decreased 3 percent by introducing an error of 1 percent in testing. This means in a plant averaging 700 pounds of butter daily, a loss or gain of 21 pounds of butter worth about $6.00, the salary of two good men. Thus it becomes evident that any practice resulting in a test uniformly high is a source of constant drain to the plant. Should the error fall in the opposite direction the plant must sooner or later suffer from a list of dissatisfied patrons, or lay themselves liable under the federal law.

OBJECT

As has already been intimated, the method of sampling cream for the determination of butter fat has been a subject of dispute and doubt, particularly since the change in manufacturing conditions have led to the delivery of a large amount of butter fat in the form of cream. The object, therefore, of this investigation is primarily to compare the efficiency of systems now in use, to test their reliability, and to form some opinion of their application and relation to creamery practice.

Since the data presented was collected incident to creamery operation and represents largely the transactions of that plant for one year, several topics of secondary interest have presented themselves, many of which seem to bear a direct relation to the subject under discussion. Where possible, such influences have actually been taken into account, but many of the facts that appear can be assigned no numerical value and at best one may only call attention to their possible influence.

METHOD OF COLLECTING DATA

As stated in the foregoing pages the data here presented covers one year's work in the creamery at the University of Illinois, making at that time an average of about 2500 pounds of butter weekly. If the sole object of the investigation had been to make mere comparisons on the various systems of sampling cream this probably could have been more successfully and more scientifically carried out entirely distinct from the commercial activity, but with the secondary object in view it seemed best not only to compare the systems on a large scale, but also to correlate them as closely as possible with modern creamery practice. This end was accomplished as each sample not only represented a comparison but also a can of cream which contributed to the creamery's daily supply. It is evident that data collected in this manner is probably more open to mechanical errors such as mixing of samples or occasional mis-reading of tests, than investigation carried on merely for its own interests, but when we take into account the number of samples tested under the commercial system, it will appear that the percentage error occasioned by such practice is practically eliminated by large numbers.

During the year the creamery had on its list at different times about 103 patrons, but the results published are on only 77 as the other 36 were taken on toward the end of the season and would not make fair comparisons

with patrons delivering cream practically the whole year.

Previous to the beginning of the experiment it had been the policy of the creamery management to pay on the basis of the ordinary creamery composite, which consists merely in a sample composed of representative amounts of cream from each delivery of a single patron for a period of fifteen days. The samples were kept in the one-half pint lightening jars with the tin cover and preserved with corrosive sublimate in tablet form, two small tablets being used during the hot months and one during the cooler season. In making the composite no effort was made to obtain a sample in proportion to the amount delivered, the object being merely to have the samples composed of cream from each delivery at the end of fifteen days, and a sample large enough for convenient manipulation in testing. It may be added, however, that this practice when averaged usually results in securing amounts of cream from each delivery which are approximately equal in volume.

A further notation is made that when the experiment began, the place of keeping the samples was changed from the regular composite room to a room directly above which offered a lighter and more convenient place for working, at the same time retaining those conditions popularly supposed to contribute to erroneous results in composite sampling.

Since the primary object was to compare individual and composite sampling, the first step was to obtain a representative sample of cream from each patron's delivery. This was usually a half pint taken from a can of cream after it had been vigorously stirred to insure a thoro remixing of the butter fat. These samples were then tested for fat, and composites made by adding approximately equal amounts of cream for each delivery to the respective composite. That is, if patron Number One delivered a can of cream, a half pint bottle was taken for a sample, tested and about one-fourth of it added to composite Number One.

APPARATUS

For the whole experiment 40-percent 18-gram bottles graduated to one-half percents were used. Scales for weighing samples were of the creamery torsion type. With but few exceptions the individual samples were tested by the writer while the composites were tested in duplicates every fifteen days. The duplicates represent the result of two men working independently rather than the closeness of duplication by one man. This offered the additional advantage of making it possible to form some opinion of variations occasioned by individuality of the testers.

DETAILS OF TESTING

In preparing the composites for testing they were handled in lots of 24 each, the capacity of the centrifuge. The samples were removed from the shelf and placed in rotation in a pan of sufficient height to permit the addition of hot water to the cream line. After warming to fluid condition the dried cream and fat was removed from the side of the bottles by means of a spatula after which the uniform sample was obtained by pouring several times from one vessel to another. An 18-gram sample was then weighed into the test bottle, after which the composite was passed to the second tester who obtained a duplicate sample.

Subsequent to the sampling the testing, with few exceptions, was carried on in the usual manner. Highly satisfactory results, were gained, however, by a slight change in manipulation, previous to the whirling. This consisted of filling the test bottles to the base of the neck with water previous to the first whirling. Experience in testing cream seems to indicate that the use of such a method resulted in a larger proportion of clear tests, and the absence of those common faults described as curdy samples and burned

fat. It may be noted in this connection that the testing of cream, and especially of composites during the summer months is frequently attended by undesirable results in the form of burned samples or otherwise cloudy tests.

The other points of difference made in testing were those of temperature and of extremities chosen to determine the length of the fat column. The latest directions given by Farrington and Woll in their book "Testing Milk and Its Products" is, in reading cream at a temperature of 140 - to "read between those points including the lower meniscus and excluding the upper." However, the exact point for reading cream is still a matter of dispute and for our purposes a rather arbitrary standard was adopted. The temperature of 120 F. seems to be most commonly used by creamerymen, so an effort was made to select a method applicable to their practice. This resulted in reading the fat column at a temperature of 120 F. between a line drawn by the lower portion of the fat column to a line taking in about one-third of the upper meniscus.

We have no data making exact comparison of this method with chemical analysis, but the results seem to correspond very closely to those obtained by the latest directions for cream reading. It may also be of interest to note in comparing several lots of butter fat received in the form of cream with this same butter fat recovered in the form of butter according to chemical analysis, that there is a consistent correlation of results. Further in comparing several churnings we note a corresponding degree of correlation between actual and possible overrun.

The following table will serve to explain the method of such calculation, as well as point out the tendency and possibility for creamery checks.

Table A

Comparing Butter Fat Churned with Butter Fat Recovered in the Butter

Date	Butter	Percent fat	Pounds fat recovered	Pounds fat by vat sample	Pounds fat by individual sample	Overrun by 1	Overrun by 2	Possible overrun less 1-½ percent for loss
Dec. 1	391	79.91	312.44	326	317.35	20.0	23.1	22.7
Dec. 2	344	82.69	284.45	275.4	273.56	24.8	25.6	19.1
Dec. 3-4	596	82.62	492.41	490	499.74	21.7	19.2	19.2
Dec. 5-7	361	82.42	297.53	296.4	301.05	21.7	21.8	19.5
Dec. 8	225	82.10	184.72	196	201.6	15.0	11.6	19.9
Dec. 9-10	383	82.95	317.69	315	335	21.5	11.3	18.7
Dec. 11	360	81.71	294.15	297	304	21.2	18.4	20.5
Dec. 12-14	360	82.13	295.66	300.4	317	19.8	13.6	19.9
Dec. 15	306	81.20	248.48	270	269	13.3	13.8	21.2
Total	3326		2727.53	2766.2	2818.3	20.2	18.0	20.0
Daily average	369.6	82.0	303.06	307.3	313.1	20.2	18.1	20.0

PRESENTATION

In the foregoing data, butter fat, as determined by sampling each lot of cream as it arrived, is referred to as individual sampling, while"proportionate sampling" is the term applied to those samples which were taken in direct proportion to the amount of cream delivered.

It will be noted that each system of sampling is partially a problem of its own and will necessarily be treated as such, preliminary to comparing it with any other system. In the general comparisons,the individual sample is used as the basis to compare from, inasmuch as this method of sampling should give results most nearly accurate.

Since all the data is taken first from the creamery records, the comparisons appear there first in terms of pounds of butter fat. Such comparisons are interesting from the standpoint of the problem of financial loss or gain accruing to each patron, but they are not on a comparable basis, as the pounds of cream for each patron might be widely different. It thus becomes evident that a system of sampling occasioning a large number of pounds variation in special instances might or might not be the cause for a high percentage variation.

In view of these facts, it seemed best to make a preliminary study of each system then compare it with the individual system, on the percentage basis. Since each composite represented the test of a patron's cream for a half month, the individual samples would be reduced to similar terms by dividing total butter fat for those fifteen days by the total cream; in other words, determining the average test. The average test representing the individual samples is then fittingly compared with any composite taken for the same length of time.

In each comparison the "Individual" sample is represented in the distribution table by the average test and the comparisons may be said to be drawn in three forms. First, in the form of distribution tables representing all the tests, second, in the form of distribution tables showing the effect of averages on the distribution, while the third is a comparison of averages expressed in terms of pounds of butter fat obtained by adding all the butter fat for the year under each system.

DIFFERENCE IN DUPLICATES

During the month previous to the beginning of this experiment preliminary data had been collected which emphasized the suggestion that there is uniform variation in testing duplicate cream samples, together with a similar variation in the results of two testers attempting to do duplicate work.

The following distribution table is a comparison of the results of Lee's and Hepburn's tests on composites and the summary is no doubt a tangible expression of the usual variation that may be expected from two experienced testers with like standards. Observations from field conditions, however, would lead one to believe that the variation of results obtained by two average practical men would considerably exceed this. This factor of variation between duplicate samples or between two testers should be born in mind in drawing other comparisons, as it must be evident that any subsequent variation must be in excess of this if it is to be attributed to method of sampling.

The following data is a comparison of Lee's composite tests with Hepburn's arranged in the form of a distribution table. Reading to the right of the zero point gives the number of Lee's composite samples with their respective percents <u>above</u> Hepburns. Reading to the left gives a similar

comparison <u>below</u> Hepburns, while the zero column represents the number of samples in which there was no variation. The comparison is based on samples of individual patrons for a period of one year.

Table I.

Comparison of Lee's and Hepburn's Testing, by Distribution

	Percent below Hepburn											Percent above Hepburns								
Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1										6	9	6	1	1							
2									2	6	10	5									
3									1	3	6	2									
4										8	9	4									
6								1	2	9	4	5	2								
7									1	3		3	1								
8						2			1	2	10	4	3								
9									1	6	9	6	1								
10										8	5	9									
11									1	3	6	2	1								
12										4	8	9									
13									1	7	9	6									
14										3	8	11									
15									2	7	7	4									
18										6	10	3	2	1							
19								1	1	5	7	7	1								
20									2	4	9	4	1								
21									1	1	12	7	2								
22										5	6	3	1								
23										8	8	6	1								
24									2	9	6	6									
25									2	7	8	5	1								
26									2	5	7	1	1								
27									3	1	8	5	1								
28								1	2	6	7	7									
29										7	3	6									
30									1	3	12	4	1								
31										7	7	2	2								
32											7	4	1								
33									1	4	7	3	1								
34										4	10	5	4								
35								1	2	1	8	4									
36							1		1	6	10	5									

Table 1. (Continued)

Patron's number	Percent below Hepburns											Percent above Hepburns								
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½ 5
37									4	6	10	3								
38							1		1	6	10	5								
39									2	1	5	2		1						
40										6	7	4	1							
41									2	9	7	5								
42								1		6	10	4	1							
43									1	6	9	3	1							
44									1	9	6	3	4							
45										2		3	1							
46									3	7	7	4	2							
48									3	7	7	4	2							
49								1		2	6	1		1						
50										3	5	4		1						
51									4	2	2									
52									1	5	5									
53									1	2	2		1							
54										3	12	6								
55										2	11	9								
56								1	1	3	8	4								
57								1	1	7	6	4								
58									1	5	8	4	2							
59										5	8	5		1						
60									1	6	7	7								
61									2	3	7	1								
63					1					6	6	4	1							
64											8	2	1							
66								2		1	7	6	1							
69										4	3	3	1	1						
70								1	1	4	9	4								
71									1	4	9	1	1	1						
75							1		1	4	7		2	2						
Total					1	2	3	11	64	300	458	265	51	10						
Average percent					.086	.17	.2	.94	5.4	25.8	39.1	22.8	4.3	.9						

From the summary of the above table, indicated by "Total" and "Average percentage variation", it is clear that there is a slight tendency on the part of Hepburn to test higher than Lee. This difference is probably the result of the use of different types of scales during the first five months of the comparison, rather than to any tendency to read differently. For it appeared from the beginning that there was a remarkable agreement in the judgment of the two testers, with respect to reading. This became more evident as the season advanced due, no doubt, to a longer experience in reading and the further establishment of a like standard.

Referring to the summary of this table, 87.7 percent of the 1165 samples reported, tested the same or fell within the limit of one-half percent variation, while there is only one instance where the difference was as much as three percent. It is further a fact worthy of comment, that the differences are approximately evenly distributed on either side of the zero line which means that in any series of such tests these irregularities tend to correct or at least to equalize each other.

Several causes are held responsible for variation of tests in creamery practice, but referring to the two comparisons just drawn, the cause of variation would probably be properly recorded under one of two heading; namely, that of lack of delicacy of apparatus used, or to some irregularity in sampling, caused by poor condition of the cream. At best, cream bottles used in the experiment could be read only as closely as one-half of one percent, which, leaving out the influence of lack of sensitiveness in cream balances and condition of cream samples, is almost sufficient to account for the variation recorded.

Comparison of Composite with Individual Sampling

Table II. is a distribution table used as a basis for comparing Hepburn's composite tests with average individual tests on each patron for periods of fifteen days, during one year. The data is arranged similar to that in Table I. The zero column shows the number of composites testing the same as the average individual tests. Reading to the right of the zero column gives the number of samples with their respective percents above the individual, while those below the zero column gives the number of samples with their respective percents below the individual.

Table II.

Comparing the Distribution of Composite Tests with Individual Tests

	Percent below Individual											Percent above Individual									
Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1								1	4	2	13	1			1	1					
2							1	2		4	4	4	5		1	1					
3								2	2	5	2		1	2							
4					2			2	2	2	7	2	1	2							1
6						1	1	4	1	5	2	3		3							
7					1					1	2	1			1	1					
8							1	2		5	3	4	1	3	1						
9						1	1	1	1	5	2	4	4		1	1	1				
10									2	3	4	8	2	1			1				
11							1		1	2	4	4	1	1	1						
12						1	1	1	3	2	3	3	3		1				1		
13								1		3	7	4	2			3					
14					1		1	1	3	2	7	1	2	1			2				
15			1							1	4	10	3	1							
18						1		2	7	6	4	1									
19								1	4	3	2	3	3	1	2	1					
20						1			3	3	5	2	1	2		1					
21								1	1	4	3	4	2	2	2		1	1			
22						1		2	1	2	2	2	4								
23					1				1	6	5	4	1	1		1			1		
24									2	8	5	2	2	1	1						
25					1			1	6	5	5	1		1							
26				1					3	1	7	2	2	1							

Table II. (Continued)

Patron's number	Percent below Individual											Percent above Individual									
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
27							1		1	5	3	1	2								
28								1	2	6	6	2		1	1						
29									2	4	6	2		2							
30								2		2	5	2	1	2	2		2				
31							1	1	5	3		1	2	1							
32								1	1	3	3	2		1							
33						1	1	1	3	4				2	1						
34						1	1	1	4	1	9	1		1				1			
35							2		2	3	2	2	1	2							
36								1	1	4	4	2	1		2	2	1				
37								1	1	4	1	3	2	2	3		2				
38							1			6	5	2	3	2	1		1				
39					1	1		1	1	1	3		2	1							
40									1	3	4	4		4	1	1					
41					1				1	4	9	2	4								
42									4	2	8	3	3		1						
43						1	1	1	3	5	3	3	1								
44						3		1	3	3	3	5	1	1		1					
45										2	1	1									
46								3	1	3	7	2	3		2						
48							2	1	2	5	3	1	4			1					
49								2		3	1	2	1		1						
50					1					1	1	2	1	1		1					
51										2	1		2								
52								2	1	2	1	2		1							
53								1		1	1	1									
54							1		2	4	3	4	3			1					
55								1	1	4	4	8		2							
56								1		5	5	1	4							1	
57							1	1	2	1	4	3	1	1	1						
58					1				5	6	3	1	2			1					
59								1	4	5	3		2				1	1	1		
60						1	1	3	1	2	3	2		3	2		1				
61								1	1	2	3	2	2		2						
63				1			3		1	4	4	2	1				1				
64							1		1		5	4									
66						1	2	1		1	2	5	2			1					
69									2	2	5	2		1							
70							2	2		4	2	4	1			1				1	
71						1		2		2	6	2	2			1					
75									2	3	4	3	3								

Total	1	2	10	16	28	58	108	207	248	161	97	54	32	21	14	3	5	1
Average percent	.093	.187	.93	1.50	2.62	5.44	10.13	19.41	23.26	15.1	9.09	5.06	3.	1.97	1.4	.28	.469	.093

Total number samples 1066

In studying the comparison of composite with individual samples, it is at once obvious that a much wider distribution is displayed than in the comparison of duplicate testing, but again, that there is a remarkable equilibrium to total results derived from the tendency for about the same number of samples to vary an equal amount in either direction.

Out of a total of 1066 samples used for comparison 36.46 percent tested higher than the individual, while 40.30 percent fell below the individual. 57.77 percent either tested the same or came within the limit, one-half percent variation. 19.22 percent of the composites varied one percent from the individual, 10.57 percent varied 1.5 percent. 5.32 percent varied two percent, while in 6.39 percent there was a variation of more than two percent. The highest variation recorded in this comparison is in two samples differing 4.5 percent from the individual.

Inasmuch as popular opinion precludes the use of the composite on the grounds that evaporation causes too high a test, special attention should be directed toward the figures showing 40.30 percent of the composites testing lower than the individual, while only 36.46 percent tested above the individual. While in this investigation we cannot hope to assign a cause to such a tendency, its presence is noted in every comparison, and from the study of this and other data it is only reasonable to conclude that factors, other than evaporation, and apparently working in the opposite direction, play no small part in the results obtained from composites.

Table III. is a complement of Table II. and needs no explanation. Since this is a comparison of Lee's composite with Individual, it should be noted that there is the same degree of correlation between Table II. and III. between the comparison of testers in Table I.

Table III.

Comparing the Distribution of Composite Samples with "Individual" Samples. Composites Tested by Lee

Patron's number	Percents below the Individual											Percents above the Individual									
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1								3	1	4	11	3				1	1				
2					1			2	1	1	6	5	4	1	1						
3								3	5		1	1	2	1							
4																					
6						1	5	3	1	4	4	1	3	1	1						
7						1			1	1	1	1				1	1	1	1		
8							1	1	4	4	4	5	1	2		1	1				
9							1	2	3	4	2	4		3	2	1		1			
10									3	1	8	7	2	2					1		
11						1			2	3	7			1	2						
12							1	1	5	5	2	2	2	3				1			
13								1	3	7	5	3	2		2		1				
14							1	1	2	6	6	4	1			2		1			
15				1					1	4	8	4	1	3							
18							2	1	9	7	2		3								
19				1				1	4	5	2	2	2	5			1	1	1		
20						1	1		2	6	8	3	1		1						
21								1	1	1	4	6	6		2	1	1	1			
22						1	1	2	1	2	4	3	2								
23										8	6	2	1	3					2		
24								3	2	4	9	1	2	2		1					
25							1	1	7	6	4	2	1								
26			1					1	4	3	3	4		1							
27					1			2	3	2	7	2	3								
28							1	1	2	8	7	3	1								
29							1		3	4	6	1	1	1							
30									3	2	6	3		4	2	1	1				
31	1			1			1	1	5	1	3		2	1	1						
32							1		2	2	4	1		2					1		
33							1	1	3	4	1	2	1	1	1		1				
34						1		1	5	2	5	3	1	1	1		2				
35							1	2	2	2	2	2	4	1							
36								1	2	3	4	5	2	2		2					
37								1	3	4	2	4	3	3	3						
38								1	1	6	2	2	4			1					
39							1	1	4	1	2		1	1							
40									2	3	4	3	4	1		1					
41							1	1	1	9	4	3	2	2							
42							1	1	5	3	4	5	1	1	2						
43							3	3	2	4	2	5	1		2						
44						1	1	1	5	3	4	5	1	1			1				
45										1	3	2									

Table III. (Continued)

Patron's number	Percents below the Individual											Percents above the Individual								
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
46							1	4	1	2	9	4		1	1						
48					1			2	1	3	6	1	4	1					1		
49								2		2	5	1		1							
50						1			1	1	3	3		1		1					
51								1	1	1	3	1									
52							3	1		2	2	1		2							
53				1				2			2	1									
54							1	1		3	6	5	3	1			1				
55								2	4	4	7	2	3								
56						1		1		1	7	3	1	2		1					
57						1		1	2	6	5	2		1							
58					1			1	5	5	5		3		1						
59							1		4	4	4	2	1	1				1	1		
60					1		2	1	2	3	4	2		2	2	1	1				
62									2	2	5	3		1	1						
63					1	1	1	1	2	6	3	2		1		2					
64								1	2		4	3	1								
66						1	2		1	3	2	4	3			1	1				
69								2		2	2	4	1	1							
70							2	1	1	5	3	2	2				1		1		
71				1				1	3	2	5	4			1	1					
75					1			1	2	1	5	1	2	2	2						
Total	1			5	7	12	40	71	149	208	282	165	92	68	31	20	15	7	9		
Average percent.	.034			.42	.58	1.01	3.4	6.	12.6	17.9	23.8	14.	7.7	5.7	2.6	1.69	1.27	.58	.76		

Total number samples 1182

The variation of Lee's composite from the Individual is practically the same as in Hepburn's and Individual. 55 percent of the samples tested the same, or fell within the limit of one-half percent variation, 20 percent varied one percent from the individual, 11.7 percent 1.5 from the individual, 6 percent 2 percent, while 7 percent varied more than 2 percent. The highest variation was 5 percent in one sample.

PROPORTIONATE SAMPLING

The comparison of the individual samples with proportionate composite in on a slightly different basis than those comparisons involving individual and ordinary composites, since the data covers a period of only six months and consequently, represents about half the number of samples used in former comparisons.

The proportionate sample was taken by means of a graduated pipette, the size varying in different instances from 1 c.c. per pound of cream, to 10 or 20 c.c. The amount of cream usually delivered by the patron was the standard determining the ratio to be used and an effort was made in this case, as with the regular composite, to have a sample at the end of fifteen days, large enough to be convenient for manipulation in testing. In this we were successful only in so far as we were able to estimate the amount of cream to be delivered by a patron for fifteen days, so it often happened that the sample for the testing period would be represented by a smaller amount of cream than is suitable for the best results.

Theoritically composites taken in proportion to the amount of cream, should give results corresponding most closely to the individual testing and such would probably be the case in sampling milk or thin cream, but the mechanical difficulties attending the use of such a system with heavy cream

render it almost useless in practical work. With thick, sour or viscous cream, such a sample becomes proportionate only in name; the amounts of cream adhering to the sides of the pipette destroy its proportionate value.

The following table illustrates by distribution, the difference between proportionate composites and Individual samples. In this as in former cases the individual is used as a standard for comparison.

Table IV.

Comparison of "Proportionate Composite Samples" with Individual Sample

Patron's number	Percent below the Individual										Percents above the Individual									
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1								2	2	2	5	1		1							
2						1			1	5	2	4									
3													1	2							
4																					
6						2		1	3		3	2		1		1					
7																					
8							2	1	1		2	1					2				
9		1							3	1	1	2	1			1	1				
10									1	1	3	1	4		2					1	
11										1	1	1		2	1						
12							2				1	3	3			2				1	
13							1	1	1	1	2	1	6								
14								1		4	1	3	3		1						
15		1									3	3	2								
18					1		2	2	5		2	1		1							
19							2		2	2	1			1	2	1	2				
20										2	3	3	1	1	1	1					
21							1	1		1	3	1		1	4					1	
22	1							1			3		1								
23								1	2	2	3		4								
24									3	3	2	1	2	1	1						
25							1		1	2	4	1									
26			1				1			1	2	1			2						
27							1	1			1	1	1			1	1				
28					1		1	1	2	2	3	1	1	1							
29								1		3	2		1								
30										2	2			2			1				
31			1				1		1	1	1	1	1			1					
32								1		1	1										
33								2		1			1			1					
34					1		1	2		3			1	2							

Table IV. (Continued)

Patron's number	Percent below the Individual											Percent above the Individual								
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
35							1				1	1		3							
36					1		1	1						2	1		1				
37									3	2	3	2	1								
38								1		1	3	2		2		1	1				
39											1						1				
40								1	1	1	3		2								
41								2	1	1	2		3		1		1				
42							1		2	1	2	2	1	1	1						
43		1	1		1	1		1	1	1	1		1					1			
44						1	2	1	2	1		3				1					
45										2	1	1									
46							1	2		1	3	2	1		1						
48								1	4	1	2	2	1								
50									1	2	1										
51								1		1	1	1					1				
52						2	3	2		1											
53								1	1	2											
54						1	1				2	2	2	2					1		
55						2		1	1	3	3										
56								1	1	2	2	1		1				1			
57	1						1	1		2		1	1								
58						1		2	2	1	2	1		1							
59							2	1	1	1		1	1								
60					1	1			2	1	2	2		1							
61										1	1	1				1	1				
63								1	1	1	2	1	2		1						
64						1	1	1			1	1	2		1						
66								3		1	1	1	1								
69										2	2	1					1				
70					1	1		1	2	2	2			1							
71								1	2	2	2			1							
75						1				1	1	2	2								
Total	1	3	3	1	7	15	30	46	56	79	104	64	55	32	20	12	14	2	4		
Average Percent	.2	.5	.5	.2	1.3	2.7	5.5	8.4	10.	14.5	19.1	11.2	10.2	5.9	3.6	2.2	2.6	.4	.7		

Total number samples 546

Table IV. illustrating the difference between proportionate and individual samples, shows a still greater latitude of distribution. 44.77 percent against 55 percent in the previous comparison, test the same or vary only one-half percent. 20.29 percent vary one percent, 14.3 percent vary 1.5 percent, 9.16 percent vary 2 percent. 11.31 percent vary more than 2 percent. The widest variation is five percent. Here again, with 44.41 percent of the samples testing <u>below</u> and 36.65 percent <u>above</u>, is a marked tendency for the composite to fall below the individual. No doubt the wider latitude of variation as well as a greater disposition to collect on the low side, in this system of sampling, is largely accounted for by the fact that comparatively smaller sized samples were obtained which allowed a proportionately greater advantage to those influences which seem to operate to lower the composits.

Table V.

Comparison of Proportionate Composite with Hepburn's Composite.

Comparison Based on a Five Months Period

	Percent Below Hepburn										Percent Above Hepburn										
Patron's Number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1				1				1	2	2	2	1	3								
2					1			1	3	1	2		1	1							
4								1	1	2	2		2		3				1		
6							1	2	1	4			3								
8				1			1		3		3		1								
9						1	1			2	2	1	1	1	2						
10										3	2	4		1	1						
11								1		1	1	2	1								
12							1				3	2	1	3							
13								2		2		2	1	1		2		1			
14							1	1		2	2	1	4								
15								1	2	3	3	1									
18						1			1	4	2	2	1								
19								1	2	2		2	1		2	1					
20											2	1	5			1					
21								2	2	3	3	1									

Table V. (Continued)

Patron's number	Percent below Hepburn											Percent above Hepburn									
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
22									1			1		1		1					
23					1	2				3	3	1		1							
24								1	2	4	4										
25							1	1	1	4	1		2		1						
26								1	1	1	1		1	1							
27						1			1			1	1	1						1	
28					1		1			2	5	1		1							
29									1	3		2		1							
30								1		1	1	2		2							
31						2		1			1	3	1								
32									1		1	1									
33									1	2		2									
34							1	1	1	2		3	1			1					
35										1	3			1							
36							1		1	2		1	2					1			
37					1	2			2	3	2		1								
38									2	2	5				2						
39													1	1							
40								1	2	2	1	2									
41									4	1		2	1			1	2				
42								1	1	3	2	1	1	2							
43									2			2				1					
44								2		2	1	1	3		2						
45									1	1	1	2									
46					1	1	1		1		3	2		1	1						
48							1	2	2		3	1	2								
50								2		2											
51									1	2	2	1									
53									3		1										
54								1	1	1	1	2		1	1						
55					1			1	1	3	2	2									
56									2	3	1	1			1	1					
57	1			1			1		1	1	1	1		1							
58									1	2	5	1		1							
59						1		1	1	2	1	1			1						
60				1					1	1	2	5									
61										1	1	2	1								
63				1	1		2	2	1		1		1	1							
64							1			2		1	3	1							
66			1					1	1	1	2	1									
69									1	1	2		1				1				
70						1		1		3	2	3									
71									4	1	1			1							
75					1		1			3	2	2	1								
Total	1		1	5	8	12	16	34	64	99	94	74	49	26	17	9	3	2	1	1	
Average percent.	.19		.19	.97	1.6	2.3	3.10	6.59	12.4	19.2	18.2	14.3	9.49	5.04	3.29	1.74	.58	.39	.19	.19	

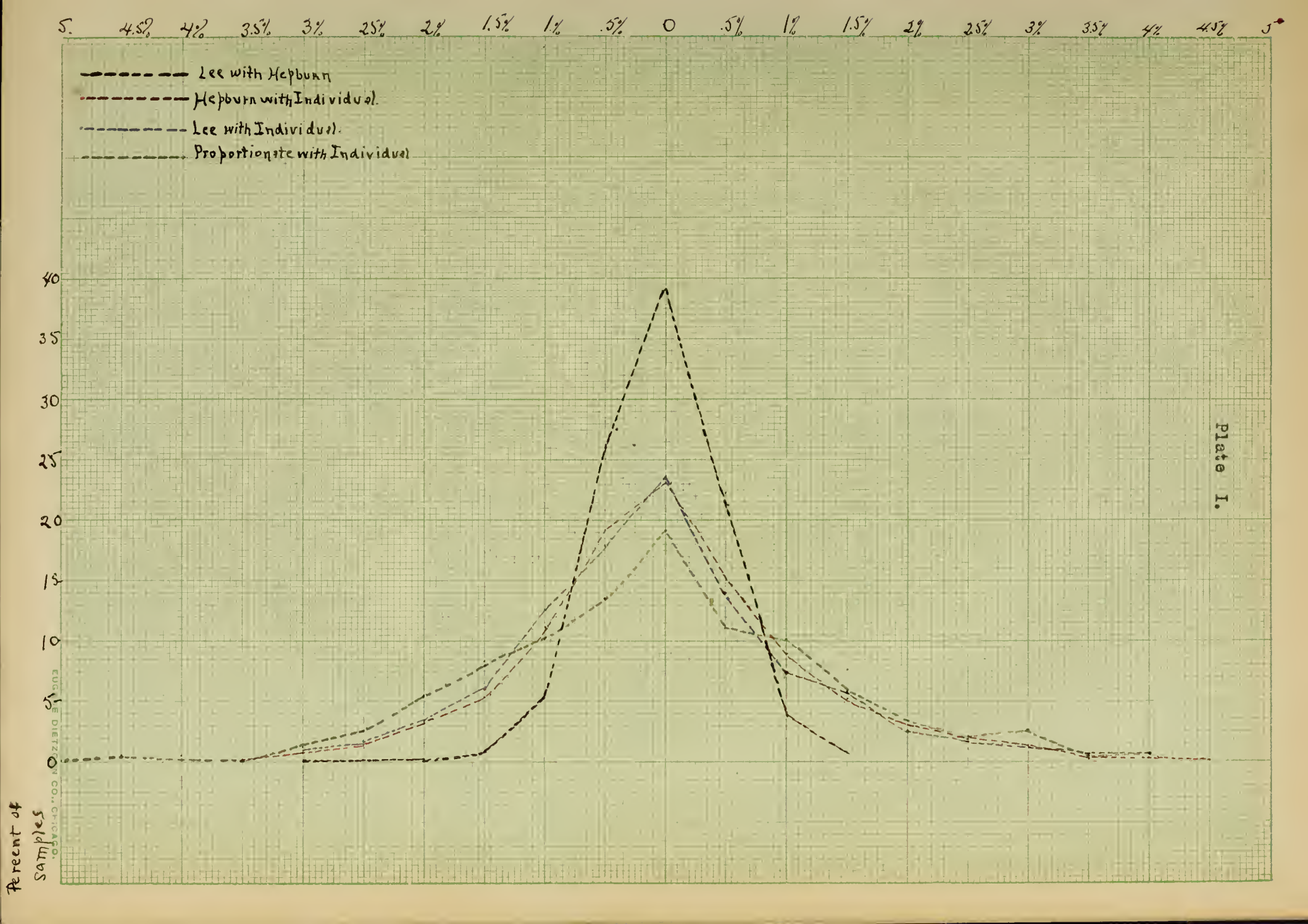
Total number of samples 516

Table VI. is the percentage summary of the distribution Tables, Number 1, Number 2, Number 3, Number 4 and Number 5, compiled here merely to show their comparative values.

Table VI.

Percentage Summary of the Distribution Tables Comparing the Distribution by Each System of Sampling

	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
Lee and Hepburn					.086	.17	.2	.94	5.48	25.8	39.1	22.8	4.3	.9	0	0	0	0	0	0	
Hepburn and individual			.09	.19	.93	1.50	2.62	5.44	10.13	19.41	23.26	15.10	9.09	5.06	3.00	1.97	1.4	.28	.47	.09	
Lee and individual				.42	.58	1.01	3.40	6.00	12.6	17.9	23.30	14.00	7.70	5.70	2.60	1.69	1.27	.58	.76		
Individual and proportionate	.18	.54	.54	.18	1.29	2.74	5.50	8.44	10.2	14.5	19.08	11.19	10.09	5.87	3.66	2.20	2.56	.36	.72		
Proportionate and Hepburn's composite	.19		.19	.97	1.55	2.32	3.10	6.39	12.4	19.18	18.21	14.34	9.49	5.04	3.29	1.74	.58	.39	.19	.19	


5. 4.5% 4% 3.5% 3% 2.5% 2% 1.5% 1% .5% 0 .5% 1% 1.5% 2% 2.5% 3% 3.5% 4% 4.5% 5
Lee with Hepburn
Hepburn with Individual.
Lee with Individual.
Proportionate with Individual
40
35
30
25
20
15
10
5
0
Percent of Samples
Plate I.
EUGENE DIETZGEN CO., CHICAGO.

The following table is a comparative expression, in terms of percent, of the variation occasioned by the different methods of sampling, with the individual used as a basis for comparison. Column 1 gives the number of samples testing the same as, or varying one-half percent from the individual. Column 2, the number varying one percent. Column 3, the number varying 1.5 percent, column 4 the number varying 2 percent, column 5 the number varying more than 2 percent. Column 6 and 7 are quite significant in that they show the total percent of samples testing above and below the individual and are consequently the one quantitative expression of the difference between the various composites and their relation to the individual. Column 8 shows the difference between 5 and 6.

Table VII.

Summary Table Comparing the Different Systems of Sampling With the Individual System

Column Number	1 Percent same or varying $\frac{1}{2}$ percent	2 Percent varying 1 percent	3 Percent varying 1.5 percent	4 Percent varying 2 percent	5 Percent varying more than 2	6 Percent above	7 Percent below	Difference
Hepburn	57.77	19.22	10.50	4.50	6.92	36.46	40.30	3.84
Lee	55.70	20.30	11.70	6.00	6.39	34.30	41.99	7.69
Proportionate	44.77	20.29	14.31	9.16	11.31	36.65	44.12	7.47

DIFFERENCE IN SAMPLES OF THE SAME KIND

From the foregoing data it is evident that there is considerable difference in tests resulting from the various commercial methods of collecting samples, which naturally leads up to the question of how much variation there might be between samples purported to be taken in the same manner. Such data would be especially interesting on the ordinary composite, since this is the usual creamery sample. It should be further suggested that any variation obtained under the systems of sampling should be in excess of this if they are to be attributed to that cause. As a means of obtaining some idea of the variation in samples taken in a like manner, two ordinary composites were collected during the last month of the experiment. These were taken after the manner described for collecting the regular composite so that either might have been used as a paying basis for that month. The results of this data are given in the following distribution table, illustrating how one test varies from another under the same system of sampling.

Table VIII.

Comparison of Composites Collected in the Same Manner

	Percent below										Percent above									
Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1											1			1							
2												2									
3																					
4											1	1									
6								1				1									
7																					
8										1						1					
9											1					1					
10												2									
12											2										
13									1		1										
14												1	1								
15										1	1										
18											1		1								

Table VIII. (Continued)

Patron's number	Percent below										Percent above									
	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
19									1		1										
20									1						1						
21															1		1				
22											1				1						
23										1		1									
24											1	1									
25									1	1											
26													1		1						
27								1				1									
28											2										
30									1		1										
32											2										
33											1	1									
34									1		1										
35								1			1										
36												1	1								
37									1				1								
38										1	1										
40									1												
41									1	1											
42													1	1							
43											1	1									
44											2										
45										1		1									
46										1		1									
51											1		1								
52								1		1											
53								1			1										
54													2								
55									1			1									
57																					
58										1		1									
59									1		1										
60							1			1										1	
61											1	1									
63											2										
64											1	1									
66				1							1										
70										1		1									
71											1										
75										1		1									
80							1					1									
81							1					1									
82											1										
83									1		1										
84											2										
86											1		1								
87						1					1										
88											1									1	
89										1				1							

Table VIII. (Continued)

Patron's number	Percent below 5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	Percent above 1½	2	2½	3	3½	4	4½	5
90												1	1								
91				1			1														
92											1				1						
93								1					1								
98											2										
99											1	1									
101												1			1						
102											1	1									
104											1		1								
105											2										
106											2										
Total				2		1	4	6	11	15	49	27	14	3	6	2			2		
Average Percent				1.4		.7	2.33	4.22	7.7	10.5	34.8	19.1	9.86	2.11	4.22	1.4			1.4		

Total number samples 142

By subtracting the variation resulting from duplicate testing, we then have some indication of variation accruing to samples taken in the same manner. This, however, is perhaps only a suggestion of results since the number of comparisons are too small to warrant any conclusions.

SEASONAL INFLUENCE

The condition of composites together with some knowledge of the causes for such conditions, is probably responsible for the inference that seasons of the year, accompanied by various intensities of heat, cold and light, have their effect upon the results obtained from the composite samples. As a means of comparing the effect of seasons, two distribution tables, numbers 9 and 10 are here presented, comparing composite with individual samples, for the winter months of December, January, February and March, and the summer months of June, July, August and September.

Table IX.

Comparison of Composites with Individual Samples for the Months of December, January, February and March

Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1									1	2	5										
2						1		1	2	1		2									
4					1				1	3	2			1							
6						1			3		2			1							
8										2	2	2	1				1				
9						1	1	1		3		2									
10									2	1	1	3						1			
12									3	2	1	2									
13										1	4	1			1	1					
14								2	1	1	4										
15			1								1	2	1	1							
18							1	2	2	2				1							
19							1			3		3				1					
20							1		1	1	2	2		1							
21								1	1	1	2	1	1					1			
22						1	1	2					2								
23										2	1	2	2				1				
24									1	2	1	1		1	2						
25									2	2	1	2				1					
26			1						1		2		1								
27											2				1						
28							1			1	6										
29										2											
30								1			3	2	2	1			1				

Table IX. (Continued)

Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
31								1						1	2						
32										4	1	1									
33													3	2				1			
34									4		3		1		1						
35							1		2			2		3							
36								1	1	2	2		1								
37								1		2		3	1		1						
38										2	2		1	2			1				
40										1	4	1	2	1							
41					1				2	1	1	1	2								
42								2	2	1	2					1					
43								2	1	2	1	3	1			1					
44			1						1	2	1	3									
45										3	1	1	1								
46								1	1		5	1									
47										2	2	2	1			1					
51									1	2	2		2								
52								2	1	2	1	2	1	1	1						
53					1				1	2	1	1									
54							1			3	2	2									
55										2	1	3	2								
56										1	1		2								
57									1		3										
58								2	2		2	1	1								
59								1	2	3	2										
60						1		4	2		3	3									
61									1		1		1								
63						1		1			3	1	1				1				
64							1		1		3	3									
66								1		1	1	3	1			1					
70					1		1			1	1	3							1		
75								1	3		1	1	1	1							
Total			2	1	4	6	10	30	50	71	95	68	36	18	9	7	5	3	1		
Average Percent		.48	.24	.95	1.44	2.4	7.22	12.1	17.1	22.6	16.4	8.7	4.33	2.16	1.7	1.2	.72	.24			

Total number samples 416

Table X.

Comparison of Composites with Individual Samples for Months of June, July, August and September

Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
1										1	3	1				1	1		1		
2								2		2	1	1	1								
3								2	1	1	1			2							
4								1	1		2	1		1						1	
6							1	1		2	2	1		1							
8							1	1		1	1			1	1						
9												2	2		2	1					
10										1	2	3	1								
11							1			1	2	2	1								
12								1	1	2	1		1		1						
13										2	2	1	2								
14										1	2	3	1								
15											2	4	1								
18									2	1	4										
19									2	1			1		1			1			
20						1			1		4			1							
21											1	2	2	1	1						
22									2	2		1	1								
23	1										2	2		1		1					
24									1	2	2	1	1								
25					1					3	2		1								
26									1		2	1	2	1							
27									3		1	1	1	1							
28										5	1			1							
29									1		3		2								
30											1			3	2		1				
31						1	1		2	1		1									
32											1		1					1			
33						1	1	1		1		1			1						
35										1	1	1	1								
36											1	3			1	2					
37									1	1		3		1	1						
38										2	2		1	1	1						
39							2	1	1		1		1	1							
40											4		3								
41											4		3								
42										1	3	2	1								
43						1	1	1	1	1	2										
44						2	1	1	1	1	1		2	1		1					
45																					
46								1	1	1		1	2		1						

Table X. (Continued)

Patron's number	5	4½	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	4½	5
48							1			2	1	1	1	1							
49								1		2	1	2	1								
50									1	3	1			1		1					
51																					
54										3	1	1	1								
55								1			2	3		1							
56								1		2	2	1							1		
57								1		1	1	2	1		1						
58										2	2	1	1			1					
59								1		1	2		1				1	1			
60										1		2		2	1		1				
61								1		2	1	1	1		1						
63					1					3	1	1									
66						1				1	1	2	1								
69									1		5			1							
70								1	1	2			1			1			1		
71									1		4		1								
75										1	2	1	1								
Total	1				2	7	10	20	27	64	91	56	48	24	16	9	4	3	3	1	
Average Percent.	.25				.52	1.8	2.6	5.2	7.	16.6	23.6	14.5	12.4	6.92	4.14	2.3	1.	.78	.78	.25	

Total number samples 386

Table XI. is compiled from IX. and X. as a summary showing the comparative percentages and their distribution, resulting from seasonal selection.

Table XI.

Percentage Summary of Distribution Tables IX. and X.

	4	3½	3	2½	2	1½	1	½	0	½	1	1½	2	2½	3	3½	4	5
Winter months.	.48	.24	.95	1.4	2.4	7.2	12.	17.1	22.6	16.4	8.7	4.3	2.2	1.7	1.2	.72	.24	
Summer months			.52	1.8	2.6	5.2	7.	.6.6	23.6	14.5	12.	6.9	4.2	2.3	1.1	.78	,78	.25

Table XII. is also derived from IX. and X., illustrating still further the comparative relation between composite and individual samples collected during the two extreme seasons of the year.

Table XII.

SEASONAL INFLUENCE

	Same or ½ percent variation	1 percent variation	1½ percent variation	2 percent variation	More than 2 percent	Percent below	Percent above	Difference
Winter	56.03	20.71	11.55	4.56	6.95	41.87	35.38	6.49
Summer	54.63	19.43	12.10	6.73	7.75	33.91	43.16	9.25

The study of seasonal influence is, in this connection, of peculiar interest since the question of difference caused by season is intimately related to influences of evaporation and other factors, potent in causing disagreement between composites and individuals. Referring to Table XII.

we note a marked tendency for the composite to fall below the individual in winter with more than a corresponding tendency for a higher test in summer. Knowing the summer conditions, one would infer that evaporation is the probable cause for these results at that season and that it might operate also in winter; but the results further lead one to recognize another influence having a marked tendency to lower the composites the effect of which is not overcome by evaporation during a greater part of the year, so that a summary for a years time shows butter fat as determined by the composite either the same or slightly below that determined by the individual.

RESULTS OF AVERAGES

Tables XIII. and XIV. are summary tables derived from data recorded under Table XVI. which gives total butter fat, cream, and average tests by patrons under each system of sampling for six months and one year. It might be added that the object of inserting the six months comparison is to show data comparable with the proportionate samples, since they were collected only for that length of time.

Tables XIII. and XIV. show the distribution of the average tests, with a marked tendency for agreement of the various systems. It is apparent that disregarding the proportionate average results for comparatively long periods show no more difference between the various systems than exists between duplicate samples.

Table XIII.

Summary of Table XVI. by Numbers

(A)

Based on period of 6 months	$2\frac{1}{2}$	2	$1\frac{1}{2}$	1	$\frac{1}{2}$	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	Total number
Lee		2	2	7	22	60	13	6	1			113
Hepburn		2	2	7	11	70	16	5	1			114
Proportionate	1	2	2	19	20	52	12	4				113

(B)

Based on period of 1 year

Lee		1	1	5	10	91	9					117
Hepburn		1	4	3	10	90	8	1				117

Table XIV.

Summary of Table XVI. by Percents

(A)

Based on period of 6 months	$2\frac{1}{2}$	2	$1\frac{1}{2}$	1	$\frac{1}{2}$	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	Total number
Lee		17	1.7	6.2	19.5	53.7	11.5	5.3	.8			
Hepburn		1.8	1.8	6.1	9.6	61.4	14.	4.4	.87			
Proportionate	.9	1.8	1.8	16.8	17.6	46.	10.8	3.6				

(B)

Based on period of 1 year

Lee		.85	.85	4.27	8.55	77.8	7.7					
Hepburn		.85	3.4	2.6	8.54	76.9	26.8	.95				

Table XVI. is still further summarized in Tables XV.A and XV.B showing the percent of samples testing the same or varying only one-half percent, those varying one percent, one and one-half percent and two percent. Since this is a quantitative record of the percentage difference based on pounds of butter fat delivered by patrons for the six months and yearly period attention should again be directed to the two columns showing the percent of composites above and below the individual.

Table XV.

Summary Table Showing Percentage Difference of Composite compared with the Individual. Results Derived from Pounds Butter Fat Delivered

(A)

Based on period of 6 months

Column	1 Same or ½ percent variation	2 1 percent	3 1½ percent	4 2 percent	5 More than 2 percent	6 Below	7 Above	8 Difference
Lee	84.70	11.8	2.5	1.7	0	29.10	17.30	
Hepburn	85.04	10.53	2.32	1.75	0	19.27	19.27	
Proportionate	84.24	20.41	1.77	1.77	.9	38.36	14.22	

(B)

Based on period of 1 year

Lee	94.05	4.27	.35	.35	0	14.52	7.7	
Hepburn	92.29	3.41	3.39	.85	0	15.34	7.69	

This Table still further emphasizes the tendency for variation of results to equalize each other especially at the end of long periods of time, indicating clearly that there is very little difference in the various methods of testing when results are compared for a season.

AVERAGES IN TERMS OF POUNDS OF BUTTER FAT

The following Table of pounds of butter fat for the year and half year for each fifteen days, presented in corroboration of former data, expresses in terms of pounds of butter fat the financial loss or gain accruing to each patron under the various systems of sampling. Column 1, of the table indicates the number of the patron; column 2, the method of sampling; column 3, the number of pounds of cream delivered for the first half year; column 4, the pounds of butter fat for six months; column 5, the average test for six months; column 6, pounds cream for one year; column 7, the butter fat for one year, and column 8, the average test.

Table XVI.

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
1	Individual	1204.5	438.35	27.4	3160	938.55	29.70
	Lee's composite		443.60	27.3		940.10	29.75
First half	Hepburn's composite		445.26	27.6		943.23	29.85
	Proportionate		431.27	27.4			
	Individual	1540.5	431.78	28.03	3244.5	949.33	29.27
	Lee's composite		430.71	27.96		949.18	29.25
Second half	Hepburn's composite		427.31	27.74		956.31	29.47
	Proportionate		425.92	27.65			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
2	Individual	1019.5	275.89	27.06	2808.5	746.79	25.59
	Lee's composite		276.38	27.13		748.54	26.65
First half	Hepburn's composite		277.19	27.19		748.99	26.67
	Proportionate		269.45	26.43			
	Individual	897	163.31	18.21	2605	661.58	25.39
	Lee's composite		162.0	18.06		660.29	25.34
Second half	Hepburn's composite		163.2	18.19		662.35	25.42
	Proportionate		161.05	17.95			
4	Individual	313	111.54	33.00	477	167.39	35.09
	Lee's composite		103.	32.91		158.08	33.14
First half	Hepburn's composite		103.35	33.02		158.73	33.27
	Proportionate		105.15	33.59			
	Individual	352	102.62	29.15	565	191.9	33.96
	Lee's composite		95.17	27.04		183.94	32.56
Second half	Hepburn's composite		95.44	27.11		184.	32.38
	Proportionate		97.59	27.72			
6	Individual	645.5	175.03	27.12	1342.5	424.68	31.63
	Lee's composite		172.8	26.78		423.21	31.52
First half	Hepburn's composite		173.09	26.81		426.89	31.79
	Proportionate		173.47	26.87			
	Individual	711.5	169.20	23.78	1437.0	455.5	31.69
	Lee's composite		167.8	23.58		444.66	30.94
Second half	Hepburn's composite		168.1	23.62		447.26	31.12
	Proportionate		164.6	23.13			
8	Individual	533.6	152.42	28.56	1189.5	457.67	38.46
	Lee's composite		153.44	28.75		449.92	37.82
First half	Hepburn's composite		157.69	28.61		448.91	37.74
	Proportionate		151.90	28.47			
	Individual	464	88.14	18.99	1267.5	447.32	35.29
	Lee's composite		85.90	19.51		533.40	34.19
Second half	Hepburn's composite		86.06	18.57		431.59	34.05
	Proportionate		85.46	18.42			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
9	Individual	875	250.55	28.6	1889.5	612.95	32.45
	Lee's composite		245.37	28.05		614.87	32.5
First half	Hepburn's composite		244.87	28.00		615.23	32.6
	Composite		246.58	28.2			
	Individual	983	287.29	28.3	2078.5	666.75	32.1
	Lee's composite		278.79	28.39		671.57	32.3
Second half	Hepburn's composite		278.57	28.35		671.66	32.35
	Proportionate		280.5	28.57			
10	Individual	885	196.89	22.2	1884.0	611.78	32.5
	Lee's composite		204.12	23.1		624.4	33.1
First half	Hepburn's composite		203.70	22.98		621.11	33.0
	Proportionate		203.78	23.0			
	Individual	811.5	176.25	21.75	2101.5	657.42	31.18
	Lee's composite		172.30	21.22		659.49	31.2
Second half	Hepburn's composite		172.92	21.4		660.47	31.3
	Proportionate		176.97	21.8			
11	Individual	599	189.51	31.65	2002	575.09	28.7
	Lee's composite		194.35	32.6		584.	29.2
First half	Hepburn's composite		194.56	32.5		590.11	29.5
	Proportionate		196.59	32.3			
	Individual	453	130.37	28.8	1894.5	561.41	29.8
	Lee's composite		127.84	28.2		561.24	29.6
Second half	Hepburn's composite		129.04	28.5		558.18	29.5
	Proportionate		129.14	28.6			
12	Individual	374	86.48	23.1	1325.5	376.13	28.4
	Lee's composite		88.45	23.6		373.57	28.2
First half	Hepburn's composite		88.1	23.58		371.76	28.0
	Proportionate		88.50	23.62			
	Individual	105	17.22	16.4	1278	388.98	30.5
	Lee's composite		16.52	15.75		372.86	29.2
Second half	Hepburn's composite		16.52	15.75		371.23	29.1
	Proportionate		15.98	15.2			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
13	Individual	1280.5	442.3	34.6	2572.4	853.22	33.2
	Lee's composite		439.34	34.3		851.48	33.1
First half	Hepburn's composite		438.41	34.2		851.21	33.1
	Proportionate		435.02	34.0			
	Individual	1098.5	368.98	33.6	2591.0	890.08	34.35
	Lee's composite		360.80	32.8		886.06	34.2
Second half	Hepburn's composite		362.60	33.0		890.29	34.4
	Proportionate		358.28	23.6			
14	Individual	639	156.68	24.5	1106.	377.95	34.1
	Lee's composite		158.76	24.8		380.65	34.4
First half	Hepburn's composite		158.36	24.82		379.60	34.3
	Proportionate		156.34	24.5			
	Individual	508	156.24	31.3	1273.5	426.13	33.45
	Lee's composite		156.5			420.89	33.0
Second half	Hepburn's composite		156.77	31.35		418.18	32.8
	Proportionate		157.17	31.45			
15	Individual	630	173.31	27.5	863	238.30	27.7
	Lee's composite		169.72	26.9		234.85	27.2
First half	Hepburn's composite		172.26	27.4		236.76	27.5
	Proportionate		169.0	26.8			
	Individual	462	125.37	26.05	1009	280.13	27.8
	Lee's composite		127.26	26.4		283.62	28.05
Second half	Hepburn's composite		129.0	26.8		284.39	28.2
	Proportionate		128.80	26.7			
18	Individual	559	209.35	37.5	1245.5	435.25	35.7
	Lee's composite		207.38	37.1		427.7	34.4
First half	Hepburn's composite		207.22	37.05		427.54	34.4
	Proportionate		205.49	36.8			
	Individual	405.5	143.71	35.4	1139.5	396.77	35 4
	Lee's composite		140.45	34.6		389.55	34.8
Second half	Hepburn's composite		140.8	34.7		383.31	34.2
	Proportionate		138.92	34.3			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
19	Individual	604	215.68	35.6	1282.0	455.07	35.45
	Lee's composite		216.	35.8		455.53	35.5
First half	Hepburn's composite		216.18	35.8		454.54	35.4
	Proportionate		219.11	36.2			
	Individual	580.5	198.02	34.1	1431	494.03	34.5
	Lee's composite		203.22	35.0		501.97	35.0
Second half	Hepburn's composite		201.78	34.7		502.19	35.1
	Proportionate		201.84	34.7			
20	Individual	382.5	106.98	27.9	1164	331.41	28.4
	Lee's composite		107.51	28.1		325.43	27.9
First half	Hepburn's composite		107.78	28.15		323.52	27.8
	Proportionate		109.01	28.5			
	Individual	328.5	89.66	27.3	1326	360.26	27.2
	Lee's composite		87.06	26.5		358.62	27.0
Second half	Hepburn's composite		87.61	26.65		360.46	27.2
	Proportionate		91.69	27.9			
21	Individual	996.5	236.8	23.8	1664.	422.4	25.4
	Lee's composite		240.11	24.1		428.4	25.7
First half	Hepburn's composite		243.33	24.4		427.28	25.45
	Proportionate		239.81	24.1			
	Individual	925	306.03	33.1	1603.5	487.97	30.4
	Lee's composite		308.23	33.4		494.93	30.8
Second half	Hepburn's		307.24	33.2		490.67	30.6
	Proportionate		299.26	32.4			
22	Individual	148.5	50.34	33.9	648	167.99	25.96
	Lee's composite		50.46	34.0		166.92	25.8
First half	Hepburn's composite		50.17	33.8		166.96	25.8
	Proportionate		48.36	32.6			
	Individual	139.5	53.86	38.6	559.5	171.07	30.6
	Lee's composite		51.60	37.0		171.01	30.4
Second half	Hepburn's composite		51.20	36.7		169.69	30.3
	Proportionate		52.66	37.7			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
23	Individual	625	166.47	26.6	1303	350.45	26.85
	Lee's composite		163.39	26.2		347.98	26.6
First half	Hepburn's composite		164.11	26.3		350.09	26.8
	Proportionate		159.56	25.5			
	Individual	404	99.90	40.5	1293	347.43	26.75
	Lee's composite		101.03	40.0		350.22	27.0
	epburn's composite		101.46	40.0		347.56	26.8
	Proportionate		99.49	40.7			
	Individual	1063.5	321.65	30.2	2556.5	793.3	31.0
	Lee's composite		326.67	30.7		787.05	30.8
	Hepburn's composite		325.59	30.6		789.25	30.9
	Proportionate		317.39	29.8			
	Individual	808	226.01	28.0	2206.5	687.99	31.1
	Lee's composite		228.60	28.3		684.05	30.9
f	Hepburn's composite		228.26	28.25		687.47	31.1
	Proportionate		227.99	28.2			
	Individual	765.5	253.09	33.05	1285.9	440.38	34.2
	Lee's composite		250.39	32.8		434.40	33.7
lf	Hepburn's composite		250.91	32.8		435.76	33.9
	Proportionate		251.17	32.8			
	Individual	431.5	144.07	33.4	1093.5	393.18	36.0
	Lee's composite		142.44	33.0		384.01	35.2
half	Hepburn's composite		141.21	32.8		384.45	35.2
	Proportionate		139.27	32.3			
	Individual	267.5	91.44	34.2	759	276.56	36.4
	Lee's composite		85.78	32.1		273.86	36.1
half	Hepburn's composite		86.30	32.4		273.98	36.1
	Proportionate		88.06	33.0			
	Individual	149.5	51.56	34.6	562	197.49	35.2
	Lee's composite		50.36	33.7		195.34	34.8
Second half	Hepburn's composite		51.48	34.4		197.68	35.2
	Proportionate		51.18	34.2			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
23	Individual	625	166.47	26.6	1303	350.45	26.85
	Lee's composite		163.39	26.2		347.98	26.6
First half	Hepburn's composite		164.11	26.3		350.09	26.8
	Proportionate		159.56	25.5			
	Individual	404	99.90	40.5	1298	347.43	26.75
	Lee's composite		101.03	40.0		350.22	27.0
Second half	Hepburn's composite		101.46	40.0		347.56	26.8
	Proportionate		99.49	40.7			
24	Individual	1063.5	321.65	30.2	2556.5	793.3	31.0
	Lee's composite		326.67	30.7		787.05	30.8
First half	Hepburn's composite		325.59	30.6		789.25	30.9
	Proportionate		317.39	29.8			
	Individual	808	226.01	28.0	2206.5	687.99	31.1
	Lee's composite		228.60	28.3		684.05	30.9
Second half	Hepburn's composite		228.26	28.25		687.47	31.1
	Proportionate		227.99	28.2			
25	Individual	765.5	253.09	33.05	1285.9	440.38	34.2
	Lee's composite		250.39	32.8		434.40	33.7
First half	Hepburn's composite		250.91	32.8		435.76	33.9
	Proportionate		251.17	32.8			
	Individual	431.5	144.07	33.4	1093.5	393.18	36.0
	Lee's composite		142.44	33.0		384.01	35.2
Second half	Hepburn's composite		141.21	32.8		384.45	35.2
	Proportionate		139.27	32.3			
26	Individual	267.5	91.44	34.2	759	276.56	36.4
	Lee's composite		85.78	32.1		273.86	36.1
First half	Hepburn's composite		86.30	32.4		273.98	36.1
	Proportionate		88.06	33.0			
	Individual	149.5	51.56	34.6	562	197.49	35.2
	Lee's composite		50.36	33.7		195.34	34.8
Second half	Hepburn's composite		51.48	34.4		197.68	35.2
	Proportionate		51.18	34.2			

Table XVI. (Continued)

Patron number	Methods of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
27	Individual	243.5	97.04	40.0	904.1	335.02	37.0
	Lee's composite		97.09	40.0		333.20	36.8
First half	Hepburn's composite		96.09	39.4		333.13	36.8
	Proportionate		95.14	39.1			
	Individual	131.	52.75	40.3	774.5	278.18	36.0
	Lee's composite		50.37	38.8		269.91	34.9
Second half	Hepburn's composite		50.37	38.7		269.79	34.8
	Proportionate		53.61	38.4			
28	Individual	375	125.44	33.5	1187.5	410.15	34.6
	Lee's composite		123.32	33.0		407.09	34.3
First half	Hepburn's composite		125.91	33.6		406.15	34.2
	Proportionate		122.7	32.7			
	Individual	338	117.21	34.7	1036	391.24	37.6
	Lee's composite		115.3	34.2		390.24	37.6
Second half	Hepburn's composite		116.24	34.4		391.17	37.75
	Proportionate		116.75	34.5			
29	Individual	464	152.02	32.8	1112	372.8	33.5
	Lee's composite		152.17	32.8		372.52	33.5
First half	Hepburn's composite		151.75	32.7		374.61	33.7
	Proportionate		150.63	32.5			
	Individual	360	119.19	33.1	1037	357.06	34.45
	Lee's composite		117.58	32.6		352.16	34.0
Second half	Hepburn's composite		117.11	32.6		351.28	33.9
	Proportionate		119.29	33.1			
30	Individual	341	80.31	23.55	784.1	172.25	22.8
	Lee's composite		82.25	24.1		183.72	23.4
First half	Hepburn's composite		82.61	24.2		183.6	23.4
	Proportionate		83.31	24.3			
	Individual	240	65.66	27.4	772.5	189.08	24.5
	Lee's composite		67.95	28.3		193.5	25.0
Second half	Hepburn's composite		66.9	27.9		192.44	24.9
	Proportionate		66.64	27.8			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
31	Individual	375.5	126.97	33.8	629	228.66	36.4
	Lee's composite		130.78	34.8		228.71	36.4
First half	Hepburn's composite		131.23	35.0		229.22	36.5
	Proportionate		128.39	34.2			
	Individual	178	63.41	35.6	465	178.77	38.4
	Lee's composite		60.90	34.2		174.25	37.5
Second half	Hepburn's composite		61.1	34.3		173.82	37.4
	Proportionate		61.76	34.7			
32	Individual	554	137.80	24.9	908	242.81	26.8
	Lee's composite		139.70	25.2		244.02	26.9
First half	Hepburn's composite		138.70	25.16		241.68	26.6
	Proportionate		138.0	24.9			
	Individual	325.5	83.10	25.6	528	133.39	25.3
	Lee's composite		81.20	25.0		141.68	26.8
Second half	Hepburn's composite		81.97	25.2		142.42	27.0
	Proportionate		81.19	25.0			
33	Individual	270	86.90	32.2	963.5	354.43	36.9
	Lee's composite		89.85	33.3		357.93	37.2
First half	Hepburn's composite		90.29	33.4		356.01	37.0
	Proportionate		89.35	33.1			
	Individual	175	62.80	35.9	838	300.19	35.8
	Lee's composite		60.45	45.5		298.58	35.6
Second half	Hepburn's composite		60.92	34.8		295.55	35.5
	Proportionate		61.00	34.9			
34	Individual	648	239.89	37.0	1397	510.	36.5
	Lee's composite		240.50	37.1		514.77	36.8
First half	Hepburn's composite		239.13	36.9		509.16	36.45
	Proportionate		240.33	37.0			
	Individual	568	192.77	33.9	1278.6	495.15	38.85
	Lee's composite		187.08	32.95		487.55	38.2
Second half	Hepburn's composite		187.32	33.0		488.04	38.3
	Proportionate		185.70	32.7			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
35	Individual	307	83.29	27.1	706	196.94	27.8
	Lee's composite		84.6	27.6		196.22	27.8
First half	Hepburn's composite		84.80	27.6		195.99	27.7
	Proportionate		84.5	27.5			
	Individual	290	48.52	16.75	551	155.13	28.2
	Lee's composite		47.5	17.4		153.87	27.9
Second half	Hepburn's composite		48.1	16.55		153.07	27.8
	Proportionate		49.6	17.1			
36	Individual	420.5	138.38	33.0	1382.5	395.14	28.6
	Lee's composite		141.05	33.6		399.03	28.85
First half	Hepburn's composite		141.53	33.7		401.87	29.0
	Proportionate		141.39	33.7			
	Individual	347	104.9	30.2	1219.5	345.44	28.3
	Lee's composite		105.93	30.5		350.84	28.8
Second half	Hepburn's composite		106.62	30.7		351.39	28.8
	Proportionate		106.62	30.7			
37	Individual	1185	350.92	29.6	1749	529.30	30.2
	Lee's composite		357.64	30.2		540.01	30.9
First half	Hepburn's composite		359.13	30.3		542.73	31.05
	Proportionate		357.5	29.3			
	Individual	836	239.35	28.6	1692	508.29	30.0
	Lee's Composite		241.54	28.8		509.88	30.1
Second half	Hepburn's composite		247.94			517.43	30.5
	Proportionate		241.35	28.35			
38	Individual	608	123.7	20.35	1255	345.33	27.5
	Lee's composite		123.59	20.3		345.45	27.5
First half	Hepburn's composite		124.95	20.55		347.85	27.7
	Proportionate		125.99	20.7			
	Individual	356	91.92		1197	355.04	29.7
	Lee's composite		93.1	26.15		357.64	29.8
Second half	Hepburn's composite		93.1	26.15		354.79	29.65
	Proportionate		93.0	26.0			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
39	Individual	63	17.65	28.0	431.5	153.99	35.7
	Lee's composite		18.59	29.5		154.13	35.8
First half	Hepburn's composite		18.59	29.5		154.54	35.9
	Proportionate		19.53	31.0		154.54	35.9
	Individual	31	8.95	28.8	349	130.44	37.35
	Lee's composite		8.68	28.0		127.08	36.4
Second half	Hepburn's composite		8.68	28.0		124.88	35.8
	Proportionate		8.99	28.8			
40	Individual	813.5	253.8	31.2	1972.5	624.95	31.7
	Lee's composite		255.41	31.4		634.26	32.15
First half	Hepburn's composite		255.58	31.4		636.87	32.3
	Proportionate		251.05	31.35			
	Individual	564	152.65	27.1	1991	627.22	31.5
	Lee's composite		153.15	72.2		628.96	31.55
Second half	Hepburn's composite		154.79	27.45		626.44	31.45
	Proportionate		151.55	26.9			
41	Individual	760	249.33	37.21	1662	446.29	26.84
	Lee's composite		248.37	37.07		442.86	26.64
First half	Hepburn's composite		246.86	36.84		440.26	26.48
	Proportionate		249.14	37.18			
	Individual	548	165.79	30.25	1850	528.87	28.53
	Lee's composite		162.77	29.7		518	28.0
Second half	Hepburn's composite		165.15	30.13			
	Proportionate		168.15	30.68			
42	Individual	673.5	181.07	26.9	1451.5	395.34	27.2
	Lee's composite		181.17	26.9		395.11	27.2
First half	Hepburn's composite		180.54	26.8		838.4	27.05
	Proportionate		180.27	26.8			
	Individual	547.5	152.96	27.9	1249	345.1	27.6
	Lee's Composite		152.94	27.9		341.91	27.3
Second half	Hepburn's composite		153.67	28.1		343.29	27.4
	Proportionate		152.6	27.9			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
43	Individual	206.5	64.65	31.3	921.5	304.92	33.0
	Lee's composite		65.5	31.7		297.93	32.4
First half	Hepburn's composite		65.08	31.5		299.12	32.5
	Proportionate		61.15	29.6			
	Individual	175.5	56.69	32.3	857.1	273.91	31.95
	Lee's composite		56.66	32.3		270.85	31.6
Second half	Hepburn's composite		56.48	32.1		272.08	31.8
	Proportionate		54.70	31.2			
44	Individual	932.5	271.5	29.15	1707.6	516.47	30.2
	Lee's composite		269.03	28.85		507.1	29.8
First half	Hepburn's composite		268.8	28.8		506.57	29.7
	Proportionate		274.79	28.4			
	Individual	557	164.28	29.5	1509	427.09	28.3
	Lee's composite		159.47	28.6		421.6	28.0
Second half	Hepburn's composite		159.38	28.6		427.71	28.4
	Proportionate		157.78	28.3			
45	Individual				166.5	41.61	25.0
	Lee's composite					42.0	25.2
First half	Hepburn's composite					40.78	24.5
	Proportionate					40.36	24.2
	Individual				239.0	61.6	25.75
	Lee's composite					61.7	25.8
Second half	Hepburn's composite					62.07	26.0
	Proportionate					62.85	26.3
46	Individual	703	236.72	33.7	1574.5	557.38	35.4
	Lee's composite		235.34	33.5		557.19	35.4
First half	Hepburn's composite		235.44	33.5		556.22	35.35
	Proportionate		236.39	33.7			
	Individual	587.5	179.14	30.5	1903.5	603.66	31.7
	Lee's composite		178.6	30.2		603.75	31.7
Second half	Hepburn's composite		179.62	30.6		604.99	31.8
	Proportionate		176.95	30.1			

Table XVI. (Continued)

Patron number	Method of sampling	For six months Pounds cream	Pounds fat	Average test	For one year Pounds cream	Pounds fat	Average test
48	Individual	758	240.25	32.6	1604	557.36	34.75
	Lee's composite		240.33	32.6		557.76	34.8
First half	Hepburn's composite		238.13	32.3		558.1	34.8
	Proportionate		236.98	32.1			
	Individual	608	189.33	31.2	1629	566.85	34.8
	Lee's composite		189.96	31.2		562.61	34.5
Second half	Hepburn's composite		192.57	31.65		566.36	34.8
	Proportionate		190.30	31.35			
49	Individual				315.5	125.11	39.7
	Lee's composite					123.84	39.3
First half	Hepburn's composite					125.6	39.8
	Proportionate						
	Individual				257	100.8	39.2
	Lee's composite					97.0	37.8
Second half	Hepburn's composite					97.0	37.8
	Proportionate						
51	Individual	371	92.73	25.0	371	92.73	25.0
	Lee's composite		92.3	24.9		92.30	24.85
First half	Hepburn's composite		93.85	25.3		93.85	25.3
	Proportionate		93.37	25.2			
	Individual	273	44.05	16.1	352	68.95	19.6
	Lee's composite		44.85	16.4		69.32	19.7
Second half	Hepburn's composite		45.12	16.5		70.02	19.9
	Proportionate		44.31	16.25			
52	Individual	541	185.82	34.3	541	185.82	34.3
	Lee's composite		183.1	33.8		183.1	33.8
First half	Hepburn's composite		183.61	33.8		183.61	33.9
	Proportionate		175.15	32.4			
	Individual	412	193.16	46.8	607.5	260.24	42.9
	Lee's composite		187.35	45.5		258.75	42.6
Second half	Hepburn's composite		189.65	46.0		261.05	43.0
	Proportionate		182.05	44.1			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
54	Individual	713	213.38	30.0	1244	399.44	32.1
	Lee's composite		217.80	30.55		406.56	32.7
First half	Hepburn's composite		215.17	30.2		403.73	32.4
	Proportionate		214.32	30.05			
	Individual	579	168.68	29.0	1258	409.75	32.6
	Lee's composite		170.01	29.4		407.8	32.45
Second half	Hepburn's composite		169.41	29.3		407.03	32.4
	Proportionate		170.76	29.5			
55	Individual	1002.5	288.62	28.8	2216	599.43	27.1
	Lee's composite		281.09	28.0		594.54	26.85
First half	Hepburn's composite		284.12	28.4		602.69	27.2
	Proportionate		278.58	27.8			
	Individual	923	258.79	28.05	2485	654.74	27.4
	Lee's composite		253.26	27.4		658.15	27.6
Second half	Hepburn's composite		256.74	27.4		666.50	27.9
	Proportionate		252.90	27.4			
56	Individual	603.5	131.63	21.8	1335.5	236.75	17.7
	Lee's composite		132.37	21.95		234.09	17.55
First half	Hepburn's composite		132.79	22.0		235.43	17.6
	Proportionate		129.09	21.4			
	Individual	471	92.98	19.7	1241.5	307.90	24.8
	Lee's composite		93.49	19.85		311.90	25.1
Second half	Hepburn's composite		93.33	19.8		312.22	25.2
	Proportionate		98.63	20.9			
57	Individual	169	50.11	29.65	673.5	199.73	29.7
	Lee's composite		51.96	29.7		196.05	29.2
First half	Hepburn's composite		51.39	29,65		197.77	29.4
	Proportionate		48.36	28.6			
	Individual	258	73.41	28.45	890	242.61	28.3
	Lee's composite		72.02	28.0		243.72	27.4
Second half	Hepburn's composite		72.79	28.0		245.13	27.55
	Proportionate		70.33	27.3			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
58	Individual	215	68.47	31.8	829	290.51	35.1
	Lee's composite		66.53	30.9		293.76	35.4
First half	Hepburn's composite		66.47	30.9		929.96	35.35
	Proportionate		64.63	30.1			
	Individual	267	89.03	33.35	748	269.28	36.0
	Lee's composite		89.97	33.7		274.87	36.7
Second half	Hepburn's composite		88.11	33.0		271.34	36.2
	Proportionate		87.57	32.8			
59	Individual	800	270.42	33.8	1450	555.42	38.4
	Lee's composite		264.98	33.05		550.59	38.0
First half	Hepburn's composite		266.17	33.25		551.87	38.1
	Proportionate		264.11	33.0			
	Individual	631	211.37	33.4	1439.5	516.75	35.9
	Lee's composite		205.9	32.6		513.76	35.6
Second half	Hepburn's composite		205.31	32.5		510.31	35.5
	Proportionate		206.75	32.8			
60	Individual	725	240.02	33.1	1493.5	453.5	30.35
	Lee's composite		239.47	33.0		454.95	30.4
First half	Hepburn's composite		237.76	32.75		453.15	30.35
	Proportionate		233.33	32.2			
	Individual	516	167.69	32.45	1418.5	436.0	30.8
	Lee's composite		160.91	31.1		441.	31.1
Second half	Hepburn's composite		163.07	31.6		443.	31.2
	Proportionate		164.04	31.8			
61	Individual	301	58.69	19.5	909.5	210.96	23.2
	Lee's composite		60.33	20.0		212.89	23.4
First half	Hepburn's composite		60.38	20.0		213.95	23.5
	Proportionate		61.49	20.4			
	Individual	327	34.38	10.65	845	180.79	21.4
	Lee's composite		35.70	10.9		182.42	21.6
Second half	Hepburn's composite		36.67	11.2		182.07	21.6
	Proportionate		36.22	11.1			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
63	Individual	345	106.78	31.0	791	234.23	29.65
	Lee's composite		109.01	31.9		230.98	29.5
First half	Hepburn's composite		108.49	31.5		231.42	29.2
	Proportionate		104.65	30.3			
	Individual		131.73	38.2		278.32	35.2
	Lee's composite		131.28	38.1		277.21	35.0
Second half	Hepburn's		132.33	38.4		276.13	34.9
	Proportionate		132.05	38.3			
66	Individual	368	88.26	24.0	836	289.33	34.6
	Lee's composite		90.76	24.7		292.14	35.0
First half	Hepburn's composite		91.36	24.8		293.61	35.05
	Proportionate		85.63	23.3			
	Individual	361	65.27	18.1	1040	347.30	33.4
	Lee's composite		64.94	18.0		343.16	33.0
Second half	Hepburn's composite		63.68	17.6		338.93	32.6
	Proportionate		63.90	17.7			
69	Individual	167	52.18	31.2	465	134.90	29.0
	Lee's composite		53.36	31.9		134.63	28.95
First half	Hepburn's composite		52.58	32.5		134.51	28.95
	Proportionate		54.9	32.9			
	Individual	206	63.43	30.8	663	193.78	29.2
	Lee's composite		63.14	30.7		192.28	29.0
Second half	Hepburn's composite		63.15	30.7		194.34	29.3
	Proportionate		62.78	30.5			
70	Individual	579	171.5	29.6	1038	380.84	36.7
	Lee's composite		169.76	29.3		378.52	36.5
First half	Hepburn's composite		169.98	29.4		380.55	36.7
	Proportionate		165.48	28.6			
	Individual	429	148.97	34.7	1042	377.33	36.2
	Lee's composite		145.92	34.0		384.	36.8
Second half	Hepburn's composite		146.74	34.2		382.7	36.7
	Proportionate		145.32	33.9			

Table XVI. (Continued)

Patron number	Method of sampling	For six months: Pounds cream	Pounds fat	Average test	For one year: Pounds cream	Pounds fat	Average test
71	Individual	661	189.66	28.65	1372	392.47	28.6
	Lee's composite		192.36	29.1		386.70	28.2
First half	Hepburn's composite		194.04	29.4		389.12	38.35
	Proportionate		188.42	28.5			
	Individual	571	156.20	27.4	1309	410.06	31.35
	Lee's composite		155.22	27.2		409.76	31.2
Second half	Hepburn's composite		155.87	27.3		410.70	31.4
	Proportionate		156.	27.35			
75	Individual	392	122.24	31.4	811	245'97	30.3
	Lee's composite		125.7	32.1		249.28	30.8
First half	Hepburn's composite		123.83	31.6		246.82	30.2
	Proportionate		120.63	30.6			
	Individual	420	129.24	30.3	788	261.58	33.15
	Lee's composite		126.60	30.2		260.23	33.0
Second half	Hepburn's composite		128.54	30.6		262.83	33.4
	Proportionate		127.02	30.3			

Table XVII. is a summary showing the total number of pounds of butter fat for each system for six months and one year.

Table XVII.

Summary in Terms of Total Fat

Total for six months				Total for one year		
Individual	Lee	Hepburn	Proportionate	Individual	Lee	Hepburn
18508.26	18455.21	18487.81	18487.81	48233.42	48105.08	~~48156.47~~ 48156.47
Difference	53.05	20.45	164.02		128.34	76.95
Percentage difference	.28	.11	.88		.27	.16

Table XVII. is a striking illustration of the tendency for variation, under the various systems of sampling, to equalize. It should be noted here also that pounds of butter fat by any system of composites falls slightly below the Individual, but that from the commercial point of view the yearly percentage difference is not worthy of comment.

On 600 pounds of butter fat, a high yearly estimate for the patrons referred to, the difference would amount to 1.62 pounds of butter fat by Lee and one pound by Hepburn.

SUMMARY

1. In testing cream, duplicates obtained by the same or different testers, are accompanied by a reasonable variation. In samples reported, 87.7 percent were exact duplicates or checked within one-half percent. 9.8 percent varied one percent from the individual, while 2-$\frac{1}{2}$ percent showed a variation of more than one percent. The above figures should be significant to those expecting exact duplicate results each time a sample is retested.

2. There is a greater latitude of variation between composites and individual samples, than there is between two sets of composites, but this variation is approximately evenly divided.

3. Of Hepburn's composites 36.40 percent tested above, while 41.99 percent fell below.

4. Two composites taken in the same manner showed the following tendency for variation. 63.73 percent were exact duplicates or varied but one-half percent. 17.60 percent varied one percent. 6.33 percent varied 1.5 percent, 7.52 varied 2 percent, 2.1 percent varied 2.5 percent, while 2.8 percent varied more than 2.5 percent.

5. During the winter months 41.87 percent of the composites tested lower than the individual, against 35.38 percent testing higher. During the summer months 33.91 percent tested lower against 43.16 testing higher.

6. The results of long time averages are seen in the figures showing that on Lee's period of six months there was only 15.7 percent of the samples varying more than one-half percent. For Hepburns period 15.9 percent

of the samples varied more than one-half percent. Under the proportionate system for a period of six months 24.75 percent of the samples varied more than a half percent.

7. Based on the year period, only 5.95 percent of Lee's samples varied more than a half percent. During the same length of time 7.78 percent of Hepburn's varied more than a half percent.

8. Results from the yearly average butter fat shows 14.52 percent of composites below the individual and 7.7 above, by Lee. For Hepburn, 15.34 percent below and 7.78 above. These results are closer than the results show by duplicate testing.

9. Results are corroborated by total pounds of butter fat in Table XVII., showing a variation between Individual and Composite samples of 27 hundredths and 16 hundredths percent, for Lee and Hepburn respectively.

CONCLUSIONS

From our knowledge of creamery conditions it is reasonable to conclude that in many instances, the system of testing to be used will be decided by the general creamery policy.

Reasonable allowance should be made for difference in duplicate samples tested by the same or different testers.

The proportionate sample taken with the graduated pipette is unsatisfactory for creamery purposes.

In testing cream there is a marked tendency for variation between composite and individual testing for short periods of time, but the distribution of this variation is such as to occasion very small amounts of difference when figured on seasonal periods.

Based on yearly averages there is practically no difference between composites and individual samples.

Composite samples tend to test higher than individual samples in summer and lower in winter. Increase in percent of fat caused by evaporation in summer may be responsible for this difference. However, this tendency seems to be more than overcome by other forces tending to lower the composite throughout the year.

Testing in creamery practice should be accorded a place of prominence commensurate with the importance of the results to be derived from it.

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